



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
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**Decision Rationale  
Total Maximum Daily Loads  
Loyalsock Creek Watershed  
For Acid Mine Drainage Affected Segments  
Sullivan and Lycoming Counties**

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**I. Introduction**

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited waterbody without violating water quality standards.

The Pennsylvania Department of Environmental Protection (PADEP), Bureau of Watershed Conservation, submitted the *Loyalsock Creek Watershed TMDL*, dated February 15, 2005 (TMDL Final Report), electronically to the Environmental Protection Agency (EPA) for final Agency review on February 15, 2005, followed by a printed copy on February 18, 2005. This report included TMDLs for three metals (aluminum, iron, and manganese) and pH. It addresses one segment (ID 7097) on Pennsylvania's 1996 Section 303(d) list of impaired waters. The segment ID of this stream was re-numbered on the 2002 and the 2004 Section 303(d) lists of impaired waters (see Table 1).

EPA's rationale is based on the TMDL Report and information contained in the attachments to the report. EPA's review determined that the TMDL meets the following eight regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDLs are designed to implement the applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a MOS.
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

## II. Summary

Table 1 presents the 1996, 1998, 2002 and draft 2004<sup>1</sup> Section 303(d) listing information for the water quality limited segments listed in 1996. The Loyalsock Creek and its segment was re-numbered in 2002 Section 303(d) list and the mercury TMDLs will be addressed in a separate TMDL Report.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 10-B West Branch Susquehanna River								
Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	13.4	7097	19804	Loyalsock Creek	TSF, CWF	305(b) Report	RE	Metals
1998	7.73	7097	19804	Loyalsock Creek	TSF, CWF	SWMP	AMD	Metals
2002*	37.45	20020111-1230-FIT	19804	Loyalsock Creek	TSF, CWF	SWMP	Unknown	Mercury
2002	6.2	990823-1330-GGM	19804	Loyalsock Creek	TSF, CWF	SWMP	AMD	Metals & Ph
2004*	37.4	20020111-1230-FIT	19804	Loyalsock Creek	TSF, CWF	SWMP	Unknown	Mercury
2004	6.2	990823-1330-GGM	19804	Loyalsock Creek	TSF, CWF	SWMP	AMD	Metals & pH

\*The 2002 listing for Source Unknown/Mercury will be addressed in a future TMDL.

Trout Stocked Fishery = TSF

Cold Water Fishery = CWF

Surface Water Monitoring Program = SWMP

Abandoned Mine Drainage = AMD

Resource Extraction = RE

See Attachment E, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists*.

The TMDLs were developed using a statistical procedure to ensure that water quality criteria are met 99 percent of the time as required by Pennsylvania's water quality standards at Pennsylvania Code Title 25, Chapter 96.3(c).

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<sup>1</sup>Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). Approval of the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report is pending. The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

TMDLs are defined as the summation of the point source WLAs plus the summation of the nonpoint source LAs plus a MOS and are often shown as:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. Since conditions, available data, and the understanding of the natural processes can change more than anticipated by the MOS, the option is always available to refine the TMDL for resubmittal to EPA for approval.

Pennsylvania's Surface Water Assessment Program (formerly the Unassessed Waters Protocol) is PADEP's method of conducting biological assessments of Pennsylvania's waters. PADEP's goal is a statewide assessment of surface waters in Pennsylvania. After completion of the initial assessments, the long-range goal is to reassess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted by additional data or other information.

### **III. Background**

The Loyalsock Creek Watershed is located in western Wyoming and northeastern Sullivan Counties, Pennsylvania (see Attachment A). The portion of the watershed covered by these TMDLs is approximately 50 miles upstream of the confluence of Loyalsock with the West Branch of the Susquehanna River with an area of 70.69 square miles. Loyalsock Creek flows from an elevation of 2130 feet in its headwaters to an elevation of 1500 feet at its confluence with the West Branch of the Susquehanna River near Williamsport. Landuses within the watershed include reclaimed and abandoned mine lands, forest lands, fish and wildlife habitat areas.

There has been a long history of underground and surface coal mining in the watershed. Locations of known coal mining operations are shown in Attachment A. Prior to 1950, deep mining operations referred to as the Connell Deep Mine Complex were responsible for most of the AMD impairment to Loyalsock Creek. After the demise of deep mining operations in the watershed, surface coal mining became prevalent.

The TMDL Report identifies past permits and shows their locations on the maps included in Attachment A. Of the more recent permits are two permits by Bernice Mining and Contracting, Inc., for surface mining operations; the Bliss Mine (SMP #57813001) and the Lewis Mine (SMP #57830101). As indicated by the final TMDL Report, these two permits have been forfeited. Therefore, all of the discharges in the watershed are from abandoned mines and are treated as nonpoint sources. Each segment on the PA Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings.

For purposes of these TMDLs only, point sources are identified as permitted discharge points and nonpoint sources are identified as other discharges from abandoned mine lands which can include tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no National Pollutant Discharge Elimination System (NPDES) permits associated with these areas. As such, the discharges associated with these landuses were assigned LAs (as opposed to WLAs for permitted point sources discharges). The decision to assign LAs to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these landuses. In addition, by approving these TMDLs with mine drainage discharges treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements. PADEP treats each segment as defined by the sampling points as a separate TMDL. The TMDLs are expressed as long-term averages. See the *Loyalsock Creek Watershed TMDL* Report, Attachment C, for TMDL calculations.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to establish a nationwide program to, among other things, protect the beneficial uses of land or water resources, and public health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA (often called “pre-law” mines), are not subject to the requirements of SMCRA.

These TMDLs were completed by PADEP to meet the eighth year (2005) TMDL milestone commitment under the requirements of the 1997 TMDL lawsuit settlement agreement. Eighth year milestones include the development of TMDLs for 20% of the waters listed on Pennsylvania’s 1996 Section 303(d) list of impaired waters by the effects of acid mine drainage (AMD) or 81 waters since 2003, and 20% of waters listed as impaired by non-AMD related impacts or 33 waters since 2003. Delisted waters may count for 20% of the requirement.

### ***Computational Procedure***

The TMDLs were developed using a statistical procedure to ensure that water quality criteria are met 99 percent of the time as required by Pennsylvania’s water quality standards. The Loyalsock Creek TMDL consists of three WLAs, and nine LAs (four sampling points along Loyalsock Creek and five in tributaries). Data was collected in 2002 for the TMDL calculations. Six or nine samples at each sampling station were analyzed for the completion of the TMDL.

A critical flow was not identified, and the reductions specified in this TMDL apply at all flow conditions. Regression and correlation analyses between flow and concentration almost always produce little or no correlation and disclose no critical condition.

TMDLs for each parameter were determined using a Monte Carlo simulation, @RISK,<sup>2</sup> with the measured, or existing, pollutant concentration data. For each source and pollutant, it was assumed that the observed data are lognormally distributed. Each pollutant was evaluated separately using @RISK.

Using the collected sample concentration parameters, mean and standard deviation, the simulation performs 5000 iterations and predicts an existing long-term average concentration and this analysis shows whether or not the existing data is from a population where water quality standards are exceeded more than one percent of the time. A second simulation of 5000 iterations is performed to calculate the percent reduction necessary to meet the criteria 99 percent of the time. Finally, using the calculated percent reductions, a final simulation is run to confirm that the target value for a long-term average concentration will result in meeting water quality criteria 99 percent of the time.

The existing and allowable long-term average loads were computed using the mean concentration from @RISK multiplied by the average flow. The TMDL Report points out that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

#### **IV. Discussions of Regulatory Requirements**

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance.

##### *1. The TMDLs are designed to implement the applicable water quality standards.*

Water quality standards are state regulations that define the water quality goals of a waterbody. Standards are comprised of three components, including: (1) designated uses, (2) criteria necessary to protect those uses, and (3) antidegradation provisions that prevent the degradation of water quality. All of the stream segments evaluated in the Loyalsock Creek Watershed have been designated by Pennsylvania as Trout Stocked Fishery and Cold Water Fishes with criteria to protect the aquatic life uses. The designations for these stream segments can be found at Pennsylvania Title 25 §93.91. To protect the designated uses, as well as the existing uses, the water quality criteria shown in Table 2 apply to all evaluated segments. The table includes the instream numeric criterion for each parameter and any associated specifications.

**Table 2. Applicable Water Quality Criteria**

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<sup>2</sup>@RISK - Risk Analysis and Simulation Add-in for Microsoft Excel®, Palisade Corporation, Newfield, NY.

Parameter	Criterion Value (mg/l)	Duration	Total Recoverable/ Dissolved
Aluminum (Al)	0.75	Maximum	Total Recoverable
Iron (Fe)	1.5 0.3	30-day Average Maximum	Total Recoverable Dissolved (PWS)
Manganese (Mn)	1.0	Maximum	Total Recoverable
pH	6.0 - 9.0	Inclusive	N/A

Pennsylvania Title 25 §96.3(c) requires that water quality criteria be achieved at least 99 percent of the time, and TMDLs expressed as long-term average concentrations are expected to meet these requirements. That is, the statistical Monte Carlo simulation used to develop TMDLs, WLAs and LAs for each parameter results in a determination that any required percent pollutant reduction assures that the water quality criteria will be met instream at least 99 percent of the time. The Monte Carlo simulation used 5000 iterations where each iteration was independent of all other iterations, and the observed data were assumed to be lognormally distributed for each source and pollutant.

EPA finds that these TMDLs will attain and maintain the applicable narrative and numerical water quality standards. For iron, the TMDL endpoint was expressed as total recoverable iron because all monitoring data was expressed as total recoverable iron.

The pH values shown in Table 3 were used as the TMDL endpoints for these TMDLs. In the case of freestone streams with little or no buffering capacity, the allowable TMDL endpoint for pH may be the natural background water quality; these values can get as low as 5.4 (Pennsylvania Fish and Boat Commission). However, PADEP chose to set the pH standard between 6.0 to 9.0, inclusive, which is presumed to be met when the net alkalinity is maintained above zero. This presumption is based on the relationship between net alkalinity and pH, on which PADEP based its methodology to addressing pH in the watershed. See the Loyalsock Creek Watershed TMDL Report, Attachment B. A summary of the methodology is presented as follows.

The parameter of pH, a measurement of hydrogen ion acidity presented as a negative logarithm of effective hydrogen ion concentration, is not conducive to standard statistics. Additionally, pH does not measure latent acidity that can be produced from the hydrolysis of metals. PADEP is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. Because the concentration of acidity in a stream is partially dependent upon metals, it is extremely difficult to predict the exact pH values which would result from treatment of AMD. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net

alkalinity is able to measure the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable ( $\geq 6.0$ ). Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is used to calculate the required alkalinity (and therefore, pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria. EPA finds this approach to pH to be reasonable.

PADEP also has an alkalinity standard. Alkalinity (of a minimum 20 mg/l calcium carbonate except where natural conditions are less) is related to but not identical with pH. Alkalinity is a measure of the buffering capacity of the water. Adequate buffering prevents large swings in pH with additions of small amounts of acid. Although many of the AMD-impacted streams are naturally low in alkalinity, available monitoring data does not always include upstream waters unimpacted by AMD. As PADEP does not list waters for inadequate alkalinity, TMDLs are not being developed for alkalinity but PADEP should monitor the waters for alkalinity and if, after these TMDLs are implemented, alkalinity is less than 20 mg/l or natural conditions, PADEP should list the waters for alkalinity and develop TMDLs.

*2. The TMDLs include a total allowable load as well as individual WLAs and LAs.*

There are three permitted dischargers in the watershed. For purposes of these TMDLs only, permitted dischargers are assigned wasteload allocations (WLAs) and nonpoint sources are identified as other discharges from abandoned mine lands which can include, but are not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. As such, the discharges associated with these landuses were assigned LAs (as opposed to WLAs). The decision to assign LAs to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these landuses. In addition, by approving these TMDLs with mine drainage discharges treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

The LA for each sampling point was computed using water-quality data collected from that point. The instream TMDLs for Sampling Points LYSK5.0, LYSK2.0 and LYSK0.1 consist of LAs made to the area above those points. The instream TMDLs for Sampling Point LYSK2.0 consists of a LA to the area between Sampling Points LYSK2.0 and LYSK5.0; Sampling Point LYSK0.1 consists of a LA to the area between Sample Points LYSK0.1 and LYSK2.0. The sampling points are shown on the map in Attachment A.

Once PADEP determined the allowable concentration and load for each pollutant, a mass-balance accounting was performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below. Load tracking through the watershed utilizes the change in measured loads from sample location to sample location as a guide for expected changes in the allowable loads.



PADEP used two basic rules for the load tracking between two ends of a stream segment; (1) if the measured upstream loads are less than the downstream loads, it is indicative that there is an increase in load between the points being evaluated and no instream processes are assumed, (2) if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the points, and the ratio of the decrease shall be applied to the allowable load being tracked from the upstream point.

Tracking loads through the watershed provides a picture of how the pollutants are affecting the watershed, based on the available information. The analysis is done to ensure that water quality standards will be met at all points in the stream. EPA finds this approach reasonable. Table 3 presents a summary of the allowable loads (e.g., “NA” meets WQS thus no allocation load is required) for the Loyalsock Creek Watershed. Note that any required reductions are after upstream reductions have been made.

**Table 3. Summary Table - Loyalsock Creek**

<i>Station</i>	<i>Parameter</i>	<i>Existing Load (lbs/day)</i>	<i>TMDL Allowable Load (lb/day)</i>	<i>WLA (lbs/day)</i>	<i>LA (lbs/day)</i>	<i>Load Reduction (lbs/day)</i>	<i>Percent Reduction %</i>
<b>LYSK5.0</b>	Upstream-Most Sample Point						
	Al	ND	-	-	-	-	-
	Fe	0.11	15.9	NA	15.9	0.0	0
	Mn	ND	-	-	-	-	-
	Acidity	683.8	177.8	NA	177.8	903.9	74
<b>LYSK2.0</b>							
	Al	ND	-	-	-	-	-
	Fe	ND	-	-	-	-	-
	Mn	9.6	9.6	NA	9.6	0.0	0
	Acidity	1611.9	274.0	NA	274.0	831.8	75
<b>LYSK0.1</b>	Downstream-Most Sample Point						
	Al	ND	-	-	-	-	-
	Fe	ND	-	-	-	-	-
	Mn	5.0	5.0	NA	5.0	0.0	0
	Acidity	1067.7	340.9	NA	340.9	0.0	0

Currently PADEP allocated only to nonpoint sources within the watershed. Where there are active mining operations or post-mining discharge treatment in the watershed, Federal regulations require that subsequent to TMDL development and approval, point sources permitted

effluent limitations be water quality-based.<sup>3</sup> In addition, PA Title 25, Chapter 96, Section 96.4(d) requires that WLAs shall serve as the basis for determination of permit limits for point source discharges regulated under Chapter 92 (relating to NPDES permitting, monitoring and compliance). Therefore, no new mining may be permitted within the watershed without reallocation of the TMDL.

*3. The TMDLs consider the impacts of background pollutant contributions.*

Loyalsock Creek is located in an area that was extensively mined. The TMDLs were developed using instream data which account for existing background conditions.

*4. The TMDLs consider critical environmental conditions.*

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis. The average flow for each sampling site was used to derive loading values for the TMDL.

*5. The TMDLs consider seasonal environmental variations.*

All sample sets included data points from various seasons, which together with the lack of correlations between flow and concentration, indicate that PADEP considered seasonal variations to the extent that data was available.

*6. The TMDLs include a MOS.*

The CWA and Federal regulations require TMDLs to include a MOS to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggests two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

PADEP used an implicit MOS in these TMDLs by assuming the treated instream concentration variability to be the same as the untreated stream's concentration variability. This is a more conservative assumption than the general assumption that a treated discharge has less variability than an untreated discharge. By retaining variability in the treated discharge, a lower average concentration is required to meet water quality criteria 99 percent of the time than if the variability of the treated discharge is reduced.

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<sup>3</sup>It should be noted that technology-based permit limits may be converted to water quality-based limits according to EPA's *Technical Support Document For Water Quality-based Toxics Control*, March 1991, recommendations.

With respect to iron, PADEP identified an additional implicit MOS in the analysis and TMDL development by treating the iron water quality criterion as if the 1.50 mg/l were a maximum value instead of a thirty-day average value.

*7. There is reasonable assurance that the proposed TMDLs can be met.*

There is also an active watershed group, the Loyalsock Creek Watershed Association, in the study area. Major objectives of the association are identifying discharges that exhibit characteristics of AMD and identifying abandoned surface coal areas for possible reclamation. The association has received two Growing Greener grants to provide financial assistance with their work in the watershed. It is anticipated that additional funding will be provided.

The *Recommendations* section also highlights what can be done in the watershed to eliminate or treat pollutant sources. Aside from PADEP's primary efforts to improve water quality in the Loyalsock Creek Watershed through reclamation of abandoned mine lands and through the NPDES permit program, additional opportunities for reasonable assurance exist. PADEP expects activities, such as research conducted by its Bureau of Abandoned Mine Reclamation, funding from EPA's §319 grant program, and Pennsylvania's Growing Greener program will also help remedy abandoned mine drainage impacts. PADEP also has in place an initiative that aims to maximize reclamation of Pennsylvania's abandoned mineral extraction lands. Through Reclaim PA, Pennsylvania's goal is to accomplish complete reclamation of abandoned mine lands and plugging of orphaned wells. Pennsylvania strives to achieve this objective through legislative and policy land management efforts, and activities described in the TMDL Report.

*8. The TMDLs have been subject to public participation.*

PADEP public noticed the draft TMDLs in the *Pennsylvania Bulletin* on September 25, 2004 and *The Williamsport Sun Gazette* on November 24 and December 1, 2004 to foster public comments on the allowable loads calculated. A public meeting was held on January 12, 2005 at the Blair County Courthouse in Holidaysburg, Pennsylvania, to discuss the proposed TMDLs.

Although not specifically stated in the TMDL Report, PADEP routinely posts the approved TMDL report on their web site: [www.dep.state.pa.us/watermanagement\\_apps/tmdl/](http://www.dep.state.pa.us/watermanagement_apps/tmdl/).

# **Attachment A**

## **Loyalsock Creek Watershed Maps**



